WHAT IS CLAIMED IS:

1. A permanent-magnet rotating machine comprising:

a rotor having a rotor core carrying on its curved outer surface multiple permanent magnets which are arranged in two rows along an axial direction in such a manner that the permanent magnetsin one row are skewed from the permanent magnets in the other row in a circumferential direction by a row-to-row skew angle θe expressed in terms of an electrical angle; and

a stator having a cylindrical stator core in which said rotor is disposed, said stator core being provided with stator coils for producing a rotating magnetic field which causes said rotor to rotate;

wherein a lower limit of the row-to-row skew angle θe is set at a value larger than a theoretical angle θs expressed in terms of the electrical angle given by (180 times the number of rotor poles /the least common multiple of the number of stator poles and the number of rotor poles)/(the number of permanent magnet rows along the axial direction),

a cogging torque ratio, which is the ratio of a cogging torque occurring in the absence of skew to a cogging torque occurring when the permanent magnets are skewed, at the theoretical angle θs is calculated based on the relationship between the cogging torque ratio and the row-to-row skew angle θe and properties concerning the relationship between flux density and magnetizing force of the stator core, and an upper limit of the row-to-row skew angle θe is set at a value equal to or smaller than a maximum value of the row-to-row skew angle θe at which the cogging torque ratio does not exceed the calculated cogging torque ratio at the theoretical angle θs.

2. The permanent-magnet rotating machine according to claim 1, wherein the ratio of the number of rotor poles to the number of stator poles is 2:3, the lower limit of the row-to-row skew angle θe is set at a value larger than the theoretical angle θs of 30 degrees, and the upper limit of the row-to-row skew angle θe is set at 43 degrees.

3. The permanent-magnet rotating machine according to claim 2, wherein the stator coreis divided into upper, middle and lower blocks and the upper and lower blocks are offset in the same direction with respect to the middle block to set the row-to-row skew angle θe at 15 degrees in terms of the electrical angle.

4. The permanent-magnet rotating machine according to claim 2, wherein two permanent magnets forming one pair of north and south poles are offset from equiangular points by 15 degrees so that they are located closer to each other and two permanent magnets forming an adjacent pair of north and south poles are

offset from equiangular points by 15 degrees so that they are located farther away from each other in each row of the permanent magnets.

5. The permanent-magnet rotating machine according to claim 1, wherein two permanent magnets forming one pair of north and south poles are offset from equiangular points by one-half times the theoretical angle θs so that they are located closer to each other and two permanent magnets forming an adjacent pair of north and south poles are offset from equiangular points by one-half times the theoretical angle θs so that they are located farther away from each other in each row of the permanent magnets.

6. The permanent-magnet rotating machine according to claim 1, wherein the stator core is divided into upper, middle and lower blocks and the upper and lower blocks are offset in the same direction with respect to the middle block to set the row-to-row skew angle θe at one-half times the theoretical angle θs in terms of the electrical angle.

7. A permanent-magnet rotating machine comprising:

a rotor having a rotor core carrying on its curved outer surface multiple permanent magnets which are arranged in four rows along an axial direction in such a manner that the permanent magnets in one of upper two rows are skewed from the permanent magnetsin the other of the upper two rows in a circumferential direction by a row-to-row skew angle θe1 expressed in terms of an electrical angle, as are the permanent magnetsin one of lower two rows from the permanent magnets in the other of the lower two rows by the row-to-row skew angle θe1 expressed in terms of the electrical angle, and the permanent magnets in the lower two rows are skewed from the permanent magnets in the upper two rows in the circumferential direction by a row-to-row skew angle θe2 expressed in terms of an electrical angle; and

a stator having a cylindrical stator core in which said rotor is disposed, said stator core being provided with stator coils for producing a rotating magnetic field which causes said rotor to rotate;

wherein the ratio of the number of rotor poles to the number of stator poles is 2:3, a lower limit of the row-to-row skew angle θe1 is set at a value larger than a theoretical angle θs of 30 degrees, and an upper limit of the row-to-row skew angle θe1 is set at approximately 52 degrees.

8. A permanent-magnet rotating machine comprising:

a rotor having a rotor core carrying on its curved outer surface multiple permanent magnets which are arranged in four rows along an axial direction in such a manner that the permanent magnets in one of upper two rows are skewed from the permanent magnets in the other of the upper two rows in a circumferential direction by a row-to-row skew angle θe2 expressed in terms of an electrical angle, as are the permanent magnets in one of lower two rows from the permanent magnets in the other of the lower two rows by the row-to-row skew angle θe2 expressed in terms of the electrical angle, and the permanent magnets in the lower two rows are skewed from the permanent magnets in the upper two rows in the circumferential direction by a row-to-row skew angle θe1 expressed in terms of an electrical angle; and

a stator having a cylindrical stator core in which said rotor is disposed, said stator core being provided with stator coils for producing a rotating magnetic field which causes said rotor to rotate;

wherein the ratio of the number of rotor poles to the number of stator poles is 2:3, a lower limit of the row-to-row skew angle θe1 is set at a value larger than a theoretical angle θs of 30 degrees, and an upper limit of the row-to-row skew angle θe1 is set at approximately 35 degrees.

9. The permanent-magnet rotating machine according to claim 7 , wherein said row-to-row skew angle θe2 is set at one-half times the theoretical angle θs.

10. The permanent-magnet rotating machine according to claim 8 , wherein said row-to-row skew angle θe2 is set at one-half times the theoretical angle θs.